

ACCESSION #: 9104180244

LICENSEE EVENT REPORT (LER)

FACILITY NAME: VERMONT YANKEE NUCLEAR POWER STATION PAGE: 1 OF 04

DOCKET NUMBER: 05000271

TITLE: Reactor Scram due to Mechanical Failure of 345KV Switchyard Bus
caused by Broken High Voltage Insulator Stack

EVENT DATE: 03/13/91 LER #: 91-005-00 REPORT DATE: 04/12/91

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: DONALD A. REID, PLANT MANAGER

TELEPHONE: (802) 257-7711

COMPONENT FAILURE DESCRIPTION:

CAUSE: X SYSTEM: FK COMPONENT: INS MANUFACTURER: L085

REPORTABLE NPRDS: N

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On 3/13/91 at 2228 hours, with reactor power at 100%, a Reactor scram occurred due to a generator/turbine trip as a result of the failure of an 80 ft. vertical section of 345KV Switchyard Bus (B Phase) between the Main Transformer aerial T1 disconnect switch and the horizontal bus bar spanning the 1T-11 and 81-1T-2 disconnect switches. The cause of the bus failure is attributed to a broken insulator stack which secured the bus to the tower. The plant was subsequently stabilized by resetting Primary Containment isolations, restarting Reactor Water Cleanup and establishing level control using the 10% Feedwater Regulator valve. Shutdown Cooling was later employed at 0504 hours on 3/14/91 and maintained until the necessary repairs and testing were completed. The reactor was returned to critical on 3/18/91 at 0055 hours. The need to expand present Switchyard system maintenance is being evaluated.

END OF ABSTRACT

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DESCRIPTION OF EVENT

On 3/13/91 at 2228 hours, during normal operation with Reactor power at 100%, a Reactor scram occurred as a result of a turbine trip on Generator Load Reject due to a 345KV Switchyard Tie Line Differential Fault. During the first 14 seconds of the event, the following automatic system responses occurred without Operator intervention:

- a. Trip of Tie Line breakers 1T and 81-1T.
- b. Fast Transfer of 4KV Buses and 1 and 2 to the Startup transformers.
- c. Reactor scram on Turbine Control Valve Fast Closure signal.
- d. Primary Containment Isolation System (PCIS) (JM*) Initiation, Groups 2, and 3 on Reactor Vessel "Lo" water level.

Operations personnel responded to the scram by implementing the required steps delineated in Emergency Operating Procedure OE-3100 "Scram Procedure" which governs reactor operation in a post-scram environment.

Automatic system responses a) thru c) were anticipated as a result of the 345KV Tie Line Fault. The Primary Containment Isolation System (PCIS) initiations experienced subsequent to the turbine trip were in response to the characteristic drop in Reactor water level from vessel void collapse. Vessel level, which initially dropped to a 120 inch level from the void collapse, quickly recovered with the "A" and "C" Reactor Feedwater pumps running. In an effort to control the increasing level, the "C" Reactor Feedwater pump was secured by Operations personnel. At 2230 hours (2 minutes into the event), the "A" Reactor Feedwater pump tripped on High Reactor water level (177 inches).

At 2231 hours, the Reactor scram was reset and the plant subsequently stabilized in Hot Standby by: restarting Reactor Water Cleanup; resetting PCIS Group 2, 3, and 5 isolations and establishing level control using the 10% Feedwater Regulator valve.

At 2235 hours, operators received a report from Security that a large flash had been observed in the Switchyard just prior to the Reactor scram. The local Fire Department was notified, but no fire ensued. The flash that had been observed was an electrical arc resulting from the connection break of the "B" phase.

At 2356 hours, Reactor depressurization and cool down began using the Main Condenser and the Bypass Opening Jack. At 0504 hours on 3/14/91, RHR Shutdown Cooling was established on the "B" RHR loop.

*Energy Information Identification System (EIIIS) Component Identifier

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DESCRIPTION OF EVENT (Contd.)

The reactor was returned to critical on 3/18/91 at 0055 hours.

During the course of the event, the following additional anomalies occurred:

- a) Turbine Pressure Control switched from Electrical regulation to Mechanical regulation which remained in effect during Reactor cool down.
- b) AOG "A" and "B" Train Recombiners tripped and isolated. The "B" Recombiner was reset and returned to service.
- c) RPS Alternate Power Supply breakers from MCC 8B tripped. The breakers were subsequently manually reset.
- d) Spurious Reactor and Turbine Area Radiation alarms were received during the event. The alarms were subsequently cleared and did not return.
- e) The PCIS group 2A, 3A, 5A and 5B (RWCU) isolation signals occurred within one second of the trip. These isolations were expected to occur after the low water level trip 8.5 seconds into the event.

An analysis of the above events was performed. Recorded data confirmed that the above equipment/circuitry responses occurred coincident with the Switchyard Fault. A review of recorded bus voltage data for buses supplying the above equipment and circuitry revealed that 4 separate

voltage dips on the buses had occurred during the fault. These voltage dips were concluded significant enough to cause the equipment responses experienced, which in each case, the equipment had Undervoltage features or Seal-In circuitry.

An inspection of the Switchyard was performed immediately after the event which revealed the lower section of "B" Phase bus bar to be broken off at the lower horizontal bus bar attachment point. (Reference attached pictorial.) The upper insulator stack and T connector which served as a tie point for the lower and upper bus bar sections was observed broken between the third and fourth insulators with the fourth insulator and T connector still attached to the buswork. During the course of inspections the next morning (on 3/14/91), gust of wind caused the hanging bus work to break off at the T-1 disconnect switch jaw and fall to the ground. No additional Switchyard damage occurred from the falling bus.

CAUSE OF EVENT

The root cause of the Switchyard bus failure is attributed to a failed insulator support between the bus and the tower. The lower insulator stack, which is comprised of four insulators coupled together, broke away from the tower at the base of the first insulator. This caused a swinging moment arm developing a force on the bus connector at the opposite end of the insulator. The excessive force snapped the vertical bar out of the welded socket on the horizontal bus bar. This resulted in an open circuit in "B" Phase and a "B" to "C" Phase flashover as the bus swung past the "C" Phase vertical bus bar. The combination of these two events initiated the Tie Line Differential Protective Relaying.

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ANALYSIS OF EVENT

The events detailed in this report did not have adverse safety implications.

1. The Tie Line Differential Protective Relaying operated as designed which initiated the generator trip and Fast Transfer of plant buses to the Startup transformers.
2. The Reactor Protective System operated as designed and scrambled the reactor after receiving a Turbine Control Valve fast closure signal.
3. All other safety system responded as expected.

CORRECTIVE ACTIONS

IMMEDIATE CORRECTIVE ACTIONS

1. Immediate corrective actions included recovering from the Reactor scram utilizing appropriate plant procedures.
2. Efforts were immediately initiated to repair the "B" and "C" phase vertical bus work. A visual and thermography inspection was conducted of the entire Switchyard to identify any additional trouble spots. An additional insulator on the "A" Phase was found with arc damage and subsequently replaced.
3. The Main and Auxiliary transformers were Doble tested and oil samples were taken to assess any damage which might have been caused by the Switchyard fault. No anomalies or degradation were found. The fault effects on the transformers were analyzed and determined to be bounded by the design.

LONG TERM CORRECTIVE ACTIONS

1. The plant will meet with VELCO (Vermont Electric Power Co., Inc.) and evaluate the adequacy of the Switchyard Maintenance Program.
2. The failed insulator has been returned to the manufacturer for analysis and recommendations.
3. A detailed engineering analysis of the Switchyard vertical buswork will be performed to determine the adequacy of the present mounting configuration.

The above long term corrective actions are expected to be completed by 12/31/91. Based upon analysis results and findings, additional corrective actions will be initiated as appropriate.

ADDITIONAL INFORMATION

There have been no similar events of this type reported to the Commission in the past five years.

ATTACHMENT 1 TO 9104180244

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Figure "91-05" omitted.

ATTACHMENT 1 TO 9104180244

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VERMONT YANKEE NUCLEAR POWER CORPORATION

P. O. BOX 157
GOVERNOR HUNT ROAD
VERNON, VERMONT 05354

April 12, 1991
VYV # 91-104

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D. C. 20555

REFERENCE: Operating License DPR-28
Docket No. 50-271
Reportable Occurrence No. LER # 91-05

Dear Sirs:

As defined by 10 CFR 50.73, we are reporting the attached Reportable Occurrence as LER # 91-05.

Very truly yours,

VERMONT YANKEE NUCLEAR POWER CORPORATION

Donald A. Reid
Plant Manager

cc: Regional Administrator
USNRC
Region I
475 Allendale Road
King of Prussia, PA 19406

9104180244.TXT

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